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FILE: EB-180 Gen.

23 January 1961

MEMORANDUM FOR THE RECORD

SUBJECT: Microjet-Pre-Contract Visit

1. On 18 January I visited (MB Associates,) card attached, for the purpose of discussing the present status of Microjet development and possible negotiation of a development task. MB Associates, which owns Ordtech, is composed of two partners Robert Mainhardt and Dr. Arthur Biehl. Both of these men plus a member of a Chicago banking firm compose the Board of Directors. The Chicago Banking Firm represents the capital investment. Mainhardt and Biehl have been involved with the AEC for a number of years. Mr. Mainhardt was in Washington for some time and was a member of the Government Security and Scientific Boards representing the AEC. Both men met in 1952 at the Livermore Radiation Laboratories, California and in 1956 founded Aerojet. They left Aerojet in 1959 and founded MB Associates. Their present location is a new one story building located in Walnut Creek, California. Their equipment is all new and the business offices are sumptuously furnished. A total of twelve people are currently employed.

2. MB Associates have only fired the Microjet as a single unit and not in clusters. The main problem area for the Microjet is the ignition and booster system. Each propellant grain is head end ignited using B / KNo_3 on fine copper wire. Pyrofuse, initially investigated, is only 80% efficient and costs from 9 to 14 cents per foot. The copper wire igniter appears to be 90% efficient. Each motor body is made of nylon and is ejection molded. The nozzles are also of nylon, but machined. The nozzle is an ablating type (throat diameter increase with burning time). Nylon was selected as a material for two major reasons. First, nylon is dimensionally stable; second, it has good mechanical strength characteristics.

3. A number of propellants have been evaluated for the Microjet. The most promising at the moment is X-12, made by Dow Chemical Company. This is a double base, unclassified, commercially available propellant with a I_{sp} = 200 and a density of 1.6 gm/cc. Other propellants being investigated are nitrosal and some aluminum additive types made by Dow Chemical and Hercules Powder. The burning time is about 30 milli sec, uncorrected. Peak pressure is about 2300 psi. MB Associates have invested about $75,000 on the Microjet program and have allocated about $25,000 more. Attached is a copy of their program objectives.

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4. I requested a letter proposal for the development and fabrication of 500 microjet hand held weapon (24 unit per weapon) for demonstration. MB Associates evidently were under the impression that the Agency was prepared to immediately underwrite a complete development program. I discouraged this attitude and explained that the weapon system must be accepted by the Agency before any such program could be entered into. I explained that a limited interest was expressed in favor of the system, but successful demonstration would be necessary in order to more fully evaluate its merits. I also stated that since no basic contract had been established that some months would probably elapse before any action could be taken regarding a task order.

5. Mr. Mainhardt is evidently quite familiar with major Agency structure and knows several individuals connected with the Agency including Mr. Bissell. Both Mainhardt and Biehl are witting as to my Agency affiliation by credential.

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II. MICROJET PROJECT - SUMMARY ENGINEERING REPORT

A. SUMMARY

The Microjet development program made successful progress during the month of December 1960. Specifically, the following important facts were demonstrated:

1. It was demonstrated that plastic cases (nylon) can be used for aerodynamic shapes.

2. It was demonstrated that plastic nozzles (nylon) can be used and that they ablate at an acceptable rate to keep the pressure nearly constant.

3. It was demonstrated that X-12 propellant gives a satisfactory radial burn and a specific impulse of about 150 seconds.

4. It was demonstrated that non-electrical ignition systems can be used made of 2A on copper wire.

The principal future development problems are:

1. Demonstration of reliability of ignition method.

2. Increasing the maximum velocity (through increased I_{sp}) of the missile which is currently below 3000 feet per second.

3. Demonstration of multiple firings and launch method.

4. Demonstration of aerodynamic dispersion.

5. Demonstration of impact effects.

6. Demonstration of economical fabrication techniques.

B. EXPERIMENTAL PROGRAM OBJECTIVES

1. Introduction

The purpose of this section is to outline in some detail ORDTECH's research and development program on the Microjet weapon as it can be formulated at this time (latter part of December, 1960). It is hoped

that the information contained herein will prove useful in guiding future developments for a period of a month or two, particularly since there are many choices that have to be made in the experimental program, some of which are quite arbitrary.

In order to discuss the development program further, it is probably first worthwhile to discuss, in general form, the characteristics of the final weapon assembly as it is currently envisioned. Obviously, a great number of different possible weapons, varying in size, shape, and use can be imagined. However somewhat arbitrarily, it has been decided that the basic weapon consisting of some 24 Microjets contained in a paper tube, for use by indigenous forces and designed around air droppable features, will be the objective. Later sections describe this weapon's general characteristics, the proposed method for its development, milestones and the development schedule.

2. Final Weapon Design

The general design of the proposed Microjet hand weapon is given elsewhere (see ORDTECH Report 60-01), with particular emphasis placed upon employment and usefulness in comparison with other small arms. However, at the time this early report was written, it was not clear what achievements could be made in designing a weapon about the small Microjets. For example, before the experimental program progressed to the present state, it was not known that plastic cases would be satisfactory for containing the propellant. Accordingly, it is believed that at the present time a more definitive design of the weapon, with a reasonable chance for success, can be discussed.

In trying to establish the overall characteristics of the weapon, an effort has been made to be as lenient as possible in order to obtain a weapon of some usefulness as soon as possible rather than trying to attain maximum or optimum performances. For example, (see below) a burn-out velocity (or maximum velocity) of only 3000 ft per sec is specified, whereas there is reason to believe that using optimum propellants with the nylon cases, velocities as high as 6700 ft per sec can be obtained. This does not mean that 3000 ft per second is by any means more desirable than 6700 ft per second, but does mean that the weapon would still be useful and presumably could be available sooner with these lower specifications. The following is suggested as reasonable and easily attainable characteristics of the weapon:

1. Minimum of 24 Microjets per hand weapon
2. Maximum diameter of 1.75 inches

3. Maximum weight of 3 oz but aim for 1 oz

4. Temperature stability from 32°F to 120°F

5. Minimum burn-out velocity of 3000 ft per sec

6. Dispersion - Between 20 and 40 circular mils

7. Reliability - Individual Microjet - 90% minimum
   Multiple Microjet Firing - 90% minimum

8. Storability - Minimum 3 months

9. Safety - Can be safely stored and armed before using.

10. Shock and Vibration - 3 to 300 cycles 10G's maximum

11. Waterproof - Enclosed in polyethylene or equivalent envelope - Microjets to be fired through the envelope

12. Density - For air drop - 5 to 7 lbs per cubic ft

As desirable objectives, it would make a considerable better weapon if:

1. No electricity is required.

2. The Microjets are completely plastic, including nozzles.

3. The cost is $10.00 or less per hand weapon in quantities above 10,000.

4. A payload space in the nose could be made available (if so desired).

As an initial objective, a quantity of 10,000 hand weapons (240,000 Microjets) should be a design objective; this being a sufficiently small quantity to be hand assembled and yet a sufficiently large quantity to be useful.